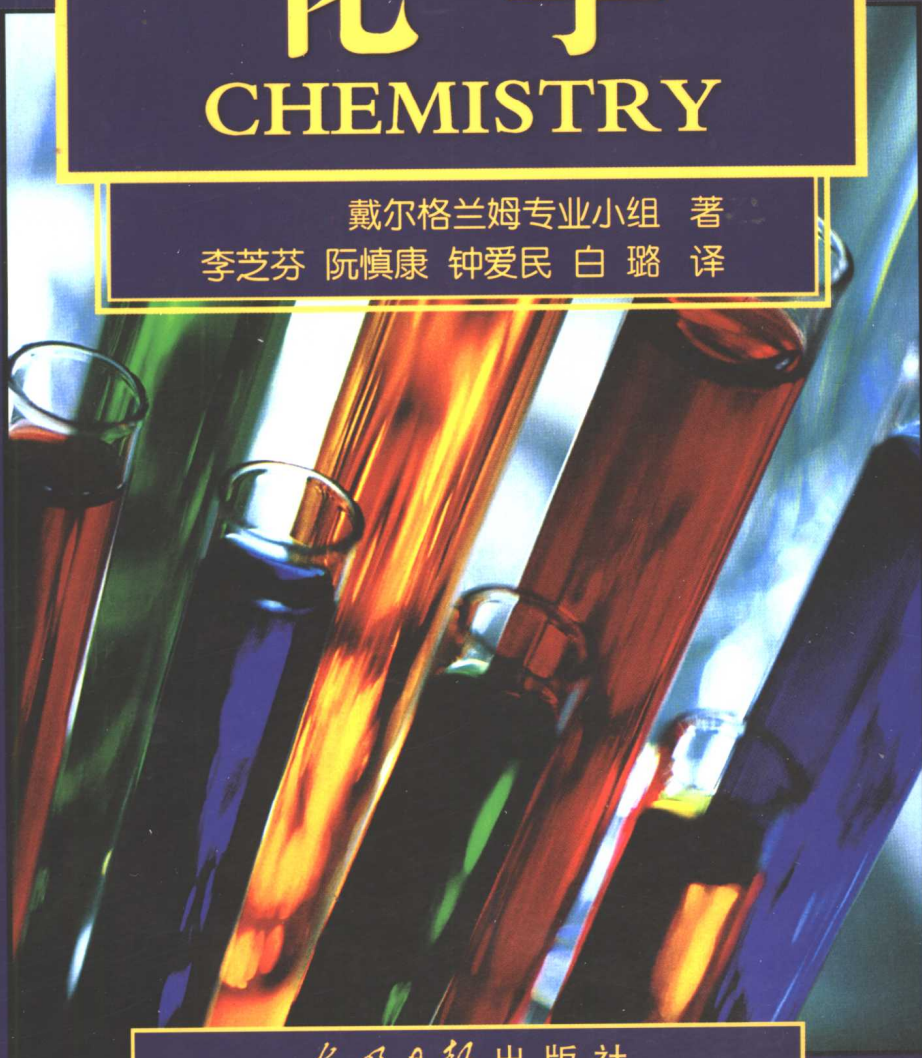


科学分类手册
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化学

CHEMISTRY

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光明日报出版社

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……对高中生和大学生大有裨益

……美国书讯

科学分类手册丛书

随着科技的发展,现在要想直接地、迅速地得到基础性科学和化学问题的解答,对学生和教师而言,正变得越来越困难。因此,他们会欢迎美国 Facts On File 出版社的《科学分类手册·化学》一书。《科学分类手册》系列涵盖了如下学科:化学、物理、生物、地球科学、海洋科学、空间与天文学、天气与气候、代数、微积分和几何,是一套不可多得的、按照系统学科分类的英汉双语词典丛书。

美国 Facts On File 出版社出版的《科学分类手册·化学》包含以下几个部分:

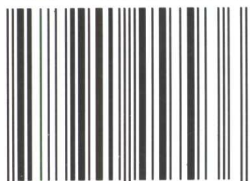
■**术语** 全书共有1400多个词条,许多条目还附有简图,以帮助解释术语的含义。主题包括:碱土金属、溴化物、碳化物、元素、荧光、第Ⅴ族元素、氦、离子、石蕊以及光致变色等。

■**人物** 介绍了从古至今的300多位化学家,他们的发现促进了人类对化学的认识与理解。这些科学家包括:阿基米德、乔治·威尔斯·比德尔、玛丽·居里、汤姆士·爱迪生、本杰明·富兰克林、阿尔弗雷德·伯恩哈特·诺贝尔、路易斯·彼斯托尔、弗兰特略克·山伽尔以及卡尔·齐格勒。

■**大事记** 跨越了近9000多年的化学发展史,包含了有关化学的重大发现和重要事件:欧洲第一铁器时代;那时铁的冶炼和加工在欧洲大陆逐渐普及(公元前950-500年);由查理迈根引入的称衡和量度的标准化(789年);英国化学家亨利·卡文迪许发现元素氢(1766年);法国化学家皮耶尔·居里和物理学家玛丽·居里发现元素镭和钋(1896年)。

由美国 Facts On File 出版社出版的本套丛书都附有便捷的索引,这将方便学生和教师快速查证。本书把化学置于科学的大背景之下,突出了所有学科之间的紧密联系,更可以比较、融会各学科领域中的信息。

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THE FACTS ON FILE
CHEMISTRY
HANDBOOK

THE DIAGRAM GROUP



Facts On File, Inc.

SECTION ONE

GLOSSARY

A(r) Symbol for relative atomic mass.

absolute temperature (thermodynamic temperature) Based on absolute zero. The unit (the kelvin) is $1/273.16$ of the temperature of the triple point of water and is equivalent to one degree Celsius (1°C).

absolute zero The lowest possible temperature. Zero on the Kelvin scale.

abundance A measure of the quantity of a substance occurring in a particular area (an element in the Earth's crust or an isotope in a sample of an element). It is expressed in percentage or parts per million.

Ac Symbol for the element actinium.

accelerator A chemical that increases the rate of a chemical reaction.

accumulator or **battery** A device that uses chemical energy to store electrical energy.

acetaldehyde *See* ethanal.

acetic acid *See* ethanoic acid.

acetone *See* propanone.

acetylene *See* ethyne.

acid Any substance that releases hydrogen ions when added to water. It has a pH of less than 7.

acid anhydrides Compounds that react with water, forming acids, for example, the acid anhydride SO_3 that reacts to make the acid H_2SO_4 .

acid-base reaction An acid and a base react together to form a salt and water only.

acidic oxide The oxides of nonmetals that form acidic solutions in water. An acidic oxide reacts with a base to form salt and water only.

acidification The fall in pH in a solution caused by the addition of an acid. This is seen in nature in the pollution of lakes, rivers, and groundwater by acid rain.

acid—organic *See* organic acid.

acid rain A form of pollution where rain dissolves acidic gases (mainly sulfur dioxide) from the air. Sulfur dioxide is released into the atmosphere by the burning of fossil fuels.

acid salt A salt of a polybasic acid in which not all the hydrogen atoms have been replaced by a metal or metal-like group (such as the ammonium group).

acid—standardization of *See* standardization of solutions.

actinides (actinoids) The name of the group of elements with atomic numbers from 89 (actinium) to 103 (lawrencium). All are radioactive and have similar properties to actinium. As their outer electronic structure is

very similar (the f orbital in their fifth shell is being filled), they have similar chemical properties.

actinium Element symbol, Ac; silvery metallic element; Z 89; A(r) 227; density (at 20°C), 10.07 g/cm³; m.p., 1050°C; radioactive; name derived from the Greek *aktis*, "ray"; discovered 1899.

actinium series One of the naturally occurring radioactive series.

activated complex A short-lived association of atoms that is formed during a chemical reaction.

activation energy The energy barrier to be overcome in order for a reaction to occur. Many chemical reactions require heat energy to be applied to reactants to initiate a reaction.

active carbon Particles of carbon used widely as an adsorbent to remove impurities in gases and liquids.

addition polymerization A process by which molecules join together by a series of addition reactions to form larger molecules, or macromolecules, which consist of repeated structural units.

addition reaction A reaction in which a molecule of a substance reacts with another molecule to form a single compound. The term addition reaction is often used in organic chemistry to describe a reaction in which an atom is added to either side of the double or triple bond in an unsaturated compound to form a saturated compound.

additive A small quantity of a compound added to a bulk material to give it certain properties. For example, the colorings added to food and drink.

adsorption The process by which molecules of gases or liquids become attached to the surface of another substance. Desorption is the opposite process.

aerosol Extremely small liquid or solid particles suspended in air or another gas.

Ag Symbol for the element silver.

agrochemicals Chemicals used in agriculture, with the exception of fertilizers. The classification includes fungicides, herbicides, pesticides, growth regulators, and vitamin and mineral supplements.

air—a mixture Air is a mixture of several gases (*see* air—composition of). These can be physically separated by cooling (to remove water vapor) and by fractional distillation (to remove nitrogen). The properties of air are an average of its components.

air—composition of The composition of air varies but its average composition (given in percentages by volume) is nitrogen, 78; oxygen, 21; argon, 0.93; carbon dioxide, 0.03.

air—liquid Liquid air is a pale blue liquid that boils at -193°C . As its component parts have different boiling points (nitrogen boils at -195.8°C , oxygen boils at -183°C), nitrogen and oxygen can be obtained by the fractional distillation of liquid air.

Al Symbol for the element aluminum.

alcohols See alkanols.

aldehydes A group of organic compounds containing the aldehyde group ($-\text{CHO}$). Names have the suffix *-al*.

algae A loose grouping of plant-like organisms including many single-celled forms and multicellular forms such as seaweeds.

algal bloom A rapidly growing layer of algae that floats on the surface of a body of water and whose growth is stimulated by nitrates and phosphates in fertilizers. This layer can cause plants growing at the bottom of the water to die as the light they need is shielded from them by the algal bloom.

aliphatic Organic compounds composed of carbon atoms in straight or branched chains.

alkali A solution of a substance in water that has a pH of more than 7 and has an excess of hydroxide ions in the solution.

alkali metals Metallic elements found in group 1 of the periodic table. They are very reactive, electropositive, and react with water to form alkaline solutions.

alkaline earth metals Metallic elements found in group 2 of the periodic table. They are less reactive and electropositive than alkali metals but also produce alkaline solutions when they react with water.

alkali—standardization of See standardization of solutions.

alkanal An aldehyde in which the radical attached to the aldehyde group is aliphatic.

alkanes A group of hydrocarbons whose general formula is $\text{C}_n\text{H}_{2n+2}$. They have single bonds between the carbon atoms and are thus said to be saturated and hence not very reactive.

alkanols (alcohols) A family of organic compounds whose structure contains the $-\text{OH}$ functional group. General formula $\text{C}_n\text{H}_{2n+1}\text{OH}$.

alkenes A group of hydrocarbons, the general formula of which is C_nH_{2n} . They are unsaturated, having a double bond between a pair of carbon atoms. They are reactive and undergo addition reactions.

alkene—substituted An alkene in which one or more hydrogen atom has been replaced by a different atom (or group of atoms).

alkylation The insertion of alkyl groups into either hydrocarbon chains or aromatic rings.

alkyl group A hydrocarbon group whose general formula is C_nH_{2n+1} .

alkynes A group of hydrocarbons whose general formula is C_nH_{2n-2} . They are unsaturated, having a triple bond between a pair of carbon atoms in each molecule and are thus reactive, undergoing addition reactions.

allo- A prefix to the name of a chemical compound that shows that the compound is a stereoisomer of a more common compound.

allotrope An element that can exist in more than one physical form while in the same state. Carbon can occur in two common allotropes, diamond and graphite (a third – buckminsterfullerene – has been discovered recently). The physical properties of these allotropes are very different.

alloy A metallic material made of two or more metals or of a metal and nonmetal. By mixing metals in certain proportions, alloys with specific properties can be made.

alpha particle A particle released during radioactive decay. It consists of two neutrons and two protons (the equivalent of the helium atom). Energy is released by this change; most is accounted for by the kinetic energy of the α particle that moves away at high speed but that rapidly loses energy by collision and ionization of other atoms and molecules and is easily stopped by a piece of paper. Alpha rays are streams of fast-moving α particles.

alumina A naturally occurring form of aluminum oxide also known as corundum.

aluminum Element symbol, Al; group 3; silvery white metallic element; Z 13; A(r) 26.98; density (at 20°C), 2.70 g/cm³; m.p., 660.4°C; name derived from the Latin *alumen*; discovered 1827.

aluminum chloride $AlCl_3$. Anhydrous aluminum chloride fumes in moist air, reacting to form hydrogen chloride with water vapor.

aluminum hydroxide $Al(OH)_3$. A white crystalline compound. It appears as a white or yellowish gelatinous mass on precipitation from solutions of ammonium salts, in which form it contains coordinated water molecules and water molecules trapped in its structure. Partially dried gels of aluminum hydroxide are used as drying agents, catalysts, and absorbents.

aluminum nitride AlN . Formed (together with the oxide) when aluminum is heated strongly.

aluminum oxide Al_2O_3 . A white or colorless crystalline compound. It is

formed by heating aluminum hydroxide and has two main forms, the alpha form and the gamma form. The alpha form occurs naturally and is known as corundum. The gamma form (activated alumina) is used as a catalyst as it has adsorptive properties. Bauxite is a hydrated form of aluminum oxide. Aluminum oxide is amphoteric. It reacts with sodium hydroxide to form sodium aluminate (NaAlO_2) and water, and with hydrochloric acid to form aluminum chloride and water.

Am Symbol for the element americium.

amalgam An alloy containing mercury.

americium Element symbol, Am; Actinide; silvery radioactive metallic element; Z 95; A(r) 243; density (at 20°C), 13.67 g/cm³; m.p., 994°C; name named for America; discovered 1944.

amide group CONH_2 . A functional group consisting of a carbon atom joined to an oxygen atom with a double bond and to a nitrogen atom that is joined to two hydrogen atoms.

amides A group of organic compounds containing the amide group. Their general formula is RCONH_2 . Amides are white solids that are soluble in alcohol and ether; some are soluble in water.

amines A group of organic compounds containing the amino functional group $-\text{NH}_2$.

amino acids A group of organic compounds containing both the carboxyl group ($-\text{COOH}$) and the amino group ($-\text{NH}_2$).

amino group $-\text{NH}_2$.

ammonia NH_3 . Colorless, strong-smelling poisonous gas, very soluble in water, forming a weak alkaline solution. $\text{NH}_3 + \text{H}_2\text{O} = \text{NH}_4^+ + \text{OH}^-$. It burns in oxygen with a yellowish flame. It is used industrially in the manufacture of fertilizers and the production of nitric acid. Most ammonia used is produced by the Haber process.

ammonia—eighty-eight A concentrated solution of ammonia in water that contains about 35% by mass of ammonia. Its relative density is 0.880 – hence the name. It softens water and helps to remove stains from clothes.

ammonia—liquor A solution of ammonia in water that is produced during coal-gas manufacture. It is used to make the fertilizer ammonium sulfate.

ammonia—oxidation If air is passed through a solution of ammonia in a flask and a red-hot platinum wire is placed at the top of the flask, the ammonia reacts with the oxygen in the air to form nitrogen monoxide. This then reacts with more oxygen to form brown fumes

of nitrogen dioxide. As the reaction is exothermic, the platinum wire continues to glow red during the reaction.

ammonia—reactions Ammonia is very soluble in water, forming a weak alkaline solution. $\text{NH}_3 + \text{H}_2\text{O} = \text{NH}_4^+ + \text{OH}^-$. Ammonia burns in oxygen with a yellowish flame and reacts with acids to form ammonium salts. Ammonium salts contain the ammonium ion NH_4^+ .

ammonia—soda process See Solvay process.

ammonia—solution Ammonia solution is a weak alkali. It precipitates insoluble hydroxides from metal salts in solution. (See ammonium hydroxide.)

ammonium carbonate $(\text{NH}_4)_2\text{CO}_3$. Formed as a sublimate (mixed with ammonium hydrogen carbonate) when calcium carbonate and ammonium sulfate (or chloride) are heated together. It is very soluble in water. Ammonium carbonate decomposes to form NH_3 , CO_2 , and H_2O on heating and decomposes in moist air to form ammonium hydrogen carbonate. It smells of ammonia, and the mixture of ammonium carbonate and ammonium hydrogen carbonate is also called sal volatile. The mixture is used in smelling salts and baking powder.

ammonium chloride NH_4Cl (also called sal ammoniac) A white crystalline solid that is soluble in water. It sublimes on heating to form ammonia and hydrogen chloride (gas). It is used in dry cells, as a flux in soldering, and as a mordant.

ammonium hydrogen carbonate NH_4HCO_3 . A white crystalline solid. It is more stable than ammonium carbonate and is therefore often used in its place both medicinally (smelling salts) and in baking powders.

ammonium hydroxide NH_4OH . It exists as an aqueous solution of ammonia and it contains ammonium ions, hydroxide ions, unionized ammonia, and water.

ammonium ion NH_4^+ . Found in ammonia solution and in ammonium compounds. Ammonium salts are similar to the salts of monovalent metals.

ammonium nitrate NH_4NO_3 . A colorless crystalline solid that dissolves readily in water. This is an endothermic reaction (the solution becomes cold), and a mixture of ammonium nitrate and water can be used as a freezing mixture (see freezing). When heated, ammonium nitrate forms dinitrogen oxide. Ammonium nitrate is used as a fertilizer and also as an explosive, with a suitable detonator, although it can detonate spontaneously.

ammonium nitrite NH_4NO_2 . Very unstable; decomposes to form nitrogen and water.

ammonium salt—test for Into a test tube containing a small amount of an aqueous solution of a base, carefully add a small amount of the compound to be tested. Add more of the compound if there is no reaction. If the compound dissolves in cold alkali and liberates a gas that turns red litmus paper blue, this indicates that the gas is ammonia and that the compound tested is an ammonium salt.
$$\text{NH}_4^+ + \text{OH}^- = \text{NH}_3 + \text{H}_2\text{O}.$$

ammonium sulfate $(\text{NH}_4)_2\text{SO}_4$. A colorless crystalline solid. It has been used as fertilizer but is now being replaced by fertilizers with higher nitrogen content. It is produced by passing ammonia and carbon dioxide into a suspension of calcium sulfate (gypsum).

amorphous Lacking form, shape, or crystal structure: amorphous substances have no fixed melting point.

amphoteric Exhibiting properties of both an acid and a base. An amphoteric compound reacts with both acids and bases to form salts.

analysis A method of finding out what the component parts of a material are. *See* qualitative analysis and quantitative analysis.

anaerobic A process that takes place in the absence of free oxygen.

anesthetic A substance used to relieve pain. General anesthetics affect the whole body, producing unconsciousness. Local anesthetics affect a specific part of the body.

anhydride The substance remaining when one or more molecules of water have been removed from an acid (or a base). Most anhydrides are good drying agents.

anhydrite Calcium sulfate (CaSO_4), which occurs naturally in an anhydrous state.

anhydrous Containing no water. Term applied to salts without water of crystallization.

anion An ion having a negative charge.

annealing A method of treating materials (metals and glass) to increase their strength and to relieve strain in their structure. The material is heated to a high temperature and then cooled slowly. In metals, this process causes large crystals to form, increasing the metal's malleability.

anode The electrode carrying the positive charge in a solution undergoing electrolysis.

anodize To coat the surface of a metal with a film of protective oxide. This can be done by making the metal the anode in an electrolysis cell.

antacid A substance such as milk of magnesia (MgO) and sodium bicarbonate (NaHCO_3) that is taken to neutralize excessive stomach acid in order to relieve indigestion.

anti-foaming powder A substance that is used in a number of processes to reduce the quantity of foam produced in order to increase the efficiency of the process. Polyamides are used in boiler systems. Low concentrations of silicones are also used widely.

antifreeze A substance that lowers the freezing point of water. Methanol and ethane-1,2-diol are examples of antifreeze agents that are added to the cooling systems of engines to prevent damage that would be caused by the formation of ice. A concentration of 30% methanol and water or 35% ethane-1,2-diol and water will remain liquid above -20.6°C .

antiknock In an internal combustion engine, gasoline and air must explode together at the correct moment or preignition occurs, making "knocking" sounds as the fuel explodes prematurely. Antiknock agents are added to the fuel to overcome this problem. They promote more efficient combustion (and increase the octane rating of the fuel). Lead(IV) tetraethyl has been an important antiknock agent, but it is being withdrawn because of problems with lead pollution. *See* octane rating.

antimony Element symbol, Sb; group 5; most stable form has bluish white metallic appearance; derivatives very toxic; Z 51; A(r) 121.75; density (at 20°C), 6.68 g/cm^3 ; m.p., 630.7°C ; Latin name, *antimonium-aktis*, "ray"; discovered before 1600; antimony compounds used in flame proofing, ceramics, and dyestuffs.

anti-oxidants Chemical additives that slow down the rate at which a substance is degraded by oxidation. When used in food, they increase the length of time a product can be kept. They are also added to paint and plastics.

aqua fortis Concentrated nitric acid.

aqua regia A mixture of one part concentrated nitric acid and three parts of concentrated hydrochloric acid. It dissolves all metals except silver.

aqueous solution A solution in which water is the solvent.

Ar Symbol for the element argon.

arene The general name for an aromatic hydrocarbon.

argon Element symbol, Ar; noble gas, group 8; Z 18; A(r) 39.95; density (STP), 1.784 g/l ; m.p., -189.2°C ; name derived from the Greek *argos*, "inactive"; discovered 1894; used in light bulbs.

aromatic compounds The group of hydrocarbons derived from benzene (C_6H_6), that have a ring structure.

arsenic Element symbol, As; group 5; a metalloid with bright metallic

appearance; Z 33; A(r) 74.92; density (at 20°C), 5.73 g/cm³; m.p., 817°C; arsenic compounds poisonous; name derived from the Greek *arsenikon*; discovered 1250; used in insecticides, semiconductors, and in alloys where it has a hardening effect.

aryl An aromatic hydrocarbon group formed by the removal of a hydrogen atom from an arene.

As Symbol for the element arsenic.

asbestos A naturally occurring fibrous material consisting mainly of calcium magnesium silicate. It has heat- (insulating and fire) proofing properties and was formerly widely used. It is now known to cause both asbestosis (a lung disease) and mesothelioma (a tumor of the epithelium lining the lungs, abdomen, or heart associated with exposure to asbestos) and its use has been greatly restricted.

association The process by which molecules of a substance combine to form a larger structure. This occurs in liquid ammonia where the liquid consists of (NH₃)_x molecules rather than separate NH₃ molecules. An associated liquid is formed when molecules of one substance are held together with molecules of another by forces weaker than normal chemical bonds. For example, a mixture of ethanol and water forms an associated liquid in which the molecules are held together by hydrogen bonds.

astatine Element symbol, At; group 7, halogen; radioactive; Z 85; A(r) 210; m.p., 302°C; name derived from the Greek *astatos*, "unstable"; discovered 1940.

At Symbol for the element astatine.

atom The smallest particle of an element that can exhibit that element's properties. An atom has a small, massive nucleus of protons and neutrons surrounded by a cloud of electrons (equal in number to the number of protons in the nucleus and unique to the element).

atomic energy The energy liberated by changes in the nuclei of atoms. When the nuclei of radioactive elements break up and other elements are formed, matter is destroyed. This matter is converted to energy in the formula $E = mc^2$. (One kilogram of matter yields 9×10^{16} joules of energy.)

atomicity The atomicity of an element is the number of atoms in one molecule of the element. For oxygen (O₂) it is 2; for ozone (O₃) 3; for hydrogen (H₂) 2.

atomic mass Short for relative atomic mass.

atomic mass unit Defined as 1/12 the mass of one atom of carbon-12 isotope.

atomic number or **proton number** (Z) The number of protons in the nucleus

of an atom. If not electrically charged, this is equal to the number of electrons in its shells.

atomic orbital *See* orbital.

atomic theory Matter consists of atoms, which are made of electrons, protons, and neutrons. Atoms can be created and destroyed in radioactive changes but not in chemical reactions. All atoms of an element contain the same number of protons. Atoms of an element may differ in mass because they contain different numbers of neutrons (*see* isotope). These do not affect their chemical properties. Chemical combination usually occurs between small, whole numbers of atoms (although it can occur between very large numbers of atoms, particularly with carbon compounds – *see* polymerization).

Au Symbol for the element gold.

Aufbau principle This governs the order in which orbitals are filled in successive elements in the periodic table: 1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, etc. The number is the shell number and the letter denotes the orbital type.

autocatalysis The action as a catalyst by one of the products of a chemical reaction.

autoclave A strong vessel in which substances may be heated under pressure in order to carry out reactions at high temperatures and pressures. Autoclaves are also used for sterilization of equipment.

Avogadro constant or number (L) The number of particles (atoms, molecules, ions) present in a mole of substance. Specifically, it is the number of atoms present in 12 g of the carbon-12 isotope (6.023×10^{23}).

Avogadro's hypothesis or law Equal volumes of all gases at the same temperature and pressure contain the same number of molecules.

azeotrope (azeotropic mixtures) A mixture of liquids that boils without a change in composition, i.e. when it boils it gives off a vapor whose composition is the same as the liquid.

azides Compounds that contain the ion N_3^- or the group $-\text{N}_3$. Heavy metal azides are explosive.

azo compound A compound that contains two aromatic rings connected by an azo group. Many azo compounds are dyes.

azo group $-\text{N}=\text{N}-$ An organic group containing two nitrogen atoms.

B Symbol for the element boron.

Ba Symbol for the element barium.

bakelite A phenol/methanal resin that was patented in 1909 by Leo Hendrik Baekeland. Bakelite is dark in color and has good electrical and heat